

## Hair fashion trends and formaldehyde health risks

More than a century ago, the American poet Emily Dickinson said, 'Beauty is not caused. It is,' yet it seems that history does not concur. Much effort has gone into 'causing' beauty, resulting in a worldwide, multibillion-dollar industry. Fashion has evolved from the Afro's, tight curls and perms of the 1970s and 1980s, to current trendy ultra-straight hair.

Although hair fibres are dead when they emerge from the scalp, variation in natural curl and hair response to cosmetics is astounding. Hair is predominantly composed of keratin polypeptide chains that are made up of amino acid building blocks. These chains twist into helical structures that are held together by hydrogen bonds, responsible for hair elasticity. When exposed to direct heat, the hydrogen bonds are temporarily broken, allowing the hair to be curled or straightened; this process is reversed by water. Polypeptides fold further as adjacent cysteine amino acids cross-link to form disulphide bonds; these determine the tensile strength, and whether hair is naturally straight or curly. Although largely resistant, disulphide bonds are broken in alkaline environments (pH 10 - 14); this explains why afro-textured hair is 'relaxed' permanently using sodium hydroxide or guanidine hydroxide (so-called lye and no-lye relaxers respectively).<sup>1</sup>

The latest hair trend to land on our shores started in Brazil about 5 years ago. The Brazilian Keratin Treatment (BKT), Brazilian Keratin Blow Out and similar products, took Hollywood and the world by storm, promising frizz-free silky straight hair. Legend has it, that the initiator of this trend was a Brazilian mortician, who noted that the hair of the deceased straightened after the embalming process. Although these products are called 'keratin' treatments, the mere application of keratin has not been shown to straighten hair; evidence suggests that the active ingredient is in fact formaldehyde (or formalin). This tissue fixative is infused into the hair cortex at very high temperatures. Therefore, the mechanism of straightening is a combination of the breakdown of hydrogen bonds by heat, and the binding of formaldehyde to amino acid side chains; this prevents the reconstitution of hydrogen bonds in the presence of water, so that the hair remains straight. Disulphide bonds remain unaffected, so the process is reversible, and the hair curl returns to normal in about 3 months. At a cost of around R1 500 per treatment, the trend is taking off in South Africa's high-end market.

Unlike scheduled medicines, cosmetics entering the market do not have to undergo routine testing; however, owing to health concerns, the keratin treatments have come under much international scrutiny. This has resulted in the emergence of newer brands that claim not to contain formaldehyde. Although formaldehyde is present in cosmetic and household products (e.g. detergents, plastics and furniture), most countries including South Africa have a legal concentration limit of 0.2%; keratin treatments contain up to 10% and more.<sup>2</sup> Some brands have been prohibited in Europe and Canada; in August, the American Food and Drug Administration (FDA) reported concentrations of 8.7 - 10.4% in the Brazilian Keratin Blow Out brand, and concluded

that the product labelling statement 'contains no formaldehyde' was misleading.<sup>3</sup> Formaldehyde is listed as a human carcinogen. Use at high concentrations or exposure to vapours should be strictly regulated; however, this is currently not possible in hair salons.

In addition to variable burning eyes, respiratory symptoms and contact dermatitis, studies report increased mortality from myeloid leukaemia in embalmers,<sup>4</sup> and 'lymphohaematopoietic' malignancies in workers<sup>5</sup> exposed to formaldehyde. The increased risk of myeloid leukaemia has been confirmed by a recent meta-analysis.<sup>6</sup> Formaldehyde has also been associated with an increase in spontaneous abortions and pregnancy complications.<sup>7</sup>

The mention of formalin conjures distinct student memories of a challenging year spent in the dissecting hall. However, the current formalin-linked controversy was rather unexpected. It is not yet evident how widespread the use of keratin products is in South Africa, or the formaldehyde concentrations thereof. Users say that these products have revolutionised their lives and reduced daily grooming to a few minutes; but is this a harmless convenience or rather, much like nicotine, a temporary pleasure with potentially dire consequences? This question cannot be answered without knowledge of formaldehyde concentrations in locally available brands. Furthermore, the acceptable widespread use of formaldehyde at low concentrations complicates matters; it would be simpler if the offending ingredient was known to be banned for cosmetic use. The hair research group at UCT is creating a national database of formaldehyde concentrations in products used in the South African market. If it is of any consolation to product users, the aim is not to be fashion killjoys or inhibitors of much needed economic growth; it is simply to protect consumers.

### Nonhlanhla P Khumalo

*Division of Dermatology  
Groote Schuur and the Red Cross War Memorial Children's Hospitals  
University of Cape Town*

*Corresponding author: N P Khumalo (n.khumalo@uct.ac.za)*

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